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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/081,426	02/22/2002	Rajendra Solanki	D8848-02	2992

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EXAMINER

FULLER, ERIC B

ART UNIT PAPER NUMBER

1762

DATE MAILED: 11/04/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/081,426

Applicant(s)

SOLANKI ET AL.

Examiner

Eric B Fuller

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 19 August 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-14 and 20-24 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-14 and 20-24 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- ☐ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1, 3-14, 20, 21, 23, and 24 rejected under 35 U.S.C. 103(a) as being unpatentable over Elers et al. (US 6,475,276 B1) in view of Norman et al. (US 5,322,712) and Rangarajan et al. (US 6,444,038 B1).

Elers teaches an ALD method of forming a copper or silver coating on a silicon substrate that has a TiN barrier layer (column 5, lines 1-35). The precursors are the same as the applicant's claims (column 5, lines 55-60). The process steps are taught in column 4, lines 19-28. The thickness is taught in column 3, line 6. The reference is silent to bubbling the carrier gas through water.

However, Norman teaches that water vapor can accelerate deposition of copper from similar precursors (column 5, lines 45-60). Therefore, it would have been obvious at the time the invention was made to a person having ordinary skill in the art to include water in the carrier gas. By doing so, one would reap the benefits of achieving accelerated deposition. Additionally, Rangarajan teaches a bubbler used for a vapor deposition process that has the advantage of providing a stable supply of feed material (column 1, lines 30-35; column 2, lines 23-45). Therefore, it would have been obvious

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at the time the invention was made to a person having ordinary skill in the art to utilize the bubbler of Rangarajan in the process taught by Elers, in view of Norman. By doing so, one would reap the benefits of providing a stable supply of water vapor to the reaction chamber.

Elers fails to explicitly teach the feed times for each reactant and purge gas. However, it would have been within the obvious skill of one practicing in the art, through routine experimentation, to determine the feed times required. By doing so, one would reap the benefits of ensuring that a uniform monolayer is formed on the substrate and/or the reaction space is sufficiently purged.

Claims 2 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Elers et al. (US 6,475,276 B1) in view of Norman et al. (US 5,322,712) and Rangarajan et al. (US 6,444,038 B1), as applied to claims 1 and 21 above, and further in view of Cho (US 5,087,485).

Elers, in view of Norman and Rangarajan, teach the limitations above, but fails to explicitly teach using alcohol as the reducing agent. However, Cho teaches using isopropanol for reducing copper precursors in a vapor deposition process. It would have been obvious at the time the invention was made to a person having ordinary skill in the art to utilize isopropanol as a reducing agent in the process taught by Elers. By doing so, one would have a reasonable expectation of success, as Cho teaches the art recognized suitability of using isopropanol to reduce copper precursors for a vapor deposition process.

Response to Arguments

Applicant argues that the Office Action fails to identify some suggestion to combine the references of Elers in view of Norman. This argument is not found persuasive. The previous Office Action explicitly stated "...with the expectation of achieving accelerated deposition". This is the motivation to combine the two references, as explicitly taught by Norman. In the current Office Action, the motivation statement has been rewritten as a separate sentence in hopes that it will be clearer to the applicant.

Applicant argues that the Office Action fails to identify some suggestion to combine the references of Elers in view of Rangarajan. This argument is not found persuasive. The previous Office Action explicitly stated "...with the expectation of of providing a stable supply of water vapor to the reaction chamber". This is the motivation to combine the two references, as explicitly taught by Rangarajan. In the current Office Action, the motivation statement has been rewritten as a separate sentence in hopes that it will be clearer to the applicant.

Applicant argues that the Office Action applies the wrong legal standard regarding obviousness. Specifically, the applicant argues that the "skill of one practicing in the art" does not mean "one of ordinary skill". Additionally, applicant argues that it is not determined what would have been within the ordinary skill of one practicing in the art. An affidavit was requested. This is not found persuasive. The sentence in question has been re-written to include "ordinary". It will now be shown how the feature

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of determining the gas feed times was within the ordinary skill of one practicing in the art.

Elers teaches the desire to form a uniform monolayer deposited and the chamber purged between deposition steps. Elers explicitly teaches that too little pulse time and the substrate doesn't achieving maximum coverage and is not a uniform monolayer and too much pulse time is wasteful because the maximum thickness is one atomic layer per pulsing sequence and the substrate is all ready saturated (column 4, lines 49-62). Therefore, although the reference is silent to the exact time required per pulse, it does teach to optimize the time such the time is long enough to saturate the substrate while not allowing the time to be too long such that gas is wasted by flowing it over a substrate that is all ready saturated. It is well settled that determination of optimum values of cause-effective variables such as this process parameter is within the ordinary skill of one practicing in the art. *In re Boesch*, 205 USPQ 215 (CCPA 1980). It would have been obvious to one of ordinary skill in the art to have determined the optimum value of a cause-effective variable such as pulse duration though routine experimentation in the absence of showing criticality in the claimed amounts. *In re Woodruff*, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990); *In re Aller*, USPQ 233 (CCPA 1955). Because it has been well-established that it would have been obvious to optimize cause-effective variables, and Elers explicitly teaches that pulse time is a cause-effective variable and teaches which results are to be achieved (saturation without waste), a affidavit stating such is believed to not be necessary.

Applicant argues that Cho is a CVD process and thus teaches away from the ALD process of Elers. This argument is not found convincing. Elers teaches to use a reducing agent that reduces copper precursors as one of the pulses of the ALD reaction. Cho teaches that isopropanol reduces copper precursors. It would have been obvious to use isopropanol in the process taught by Elers. Cho does not teach away from the reference because it is only used to teach that isopropanol has the property of being a reducing agent for copper precursors, which is all that is required by Elers.

The affidavit has been considered, but is not found convincing. The affidavit declares that CVD is different from ALD, this is acknowledged. However, the declaration fails in overcoming the position it would have been obvious at the time the invention was made to a person having ordinary skill in the art to use a known reducing agent to reduce copper precursors when the primary reference explicitly teaches to use a reducing agent.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any

extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.


Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eric B Fuller whose telephone number is (571) 272-1420. The examiner can normally be reached on Mondays through Thursdays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shrive P Beck, can be reached on (571) 272-1415. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



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